

WHAT IS CLAIMED IS:

1. A method for real time high speed high resolution hyper-spectral imaging, comprising the steps of:

- (a) emitting electromagnetic radiation in a form of an object emission beam, by objects in a scene or a sample, and collimating said object emission beam, using an electromagnetic radiation collimating element, for forming a collimated object emission beam;
- (b) receiving and dividing said collimated object emission beam by an optical interferometer, for generating an interference image; said optical interferometer includes:
 - (i) a beam splitter,
 - (ii) a fixed mirror,
 - (iii) a movable mirror, whereby said fixed mirror and said movable mirror are located at a right angle to each other, and each said mirror is oriented at a pre-determined angle relative to beam splitting surface of said beam splitter positioned at vertex of a right angle between both said mirrors,
 - (iv) a piezoelectric motor, operatively connected to said movable mirror, for displacing said movable mirror along an axis of said divided collimated object emission beam,
 - (v) a distance change feedback sensor, operatively connected to said movable mirror and operatively connected to said piezoelectric motor controller, for sensing and measuring change in distance or position of said movable mirror along said axis,
 - (vi) a piezoelectric motor controller, operatively connected to said piezoelectric motor, and operatively connected to said distance change feedback sensor, for actuating and controlling said piezoelectric motor; and
 - (vii) an optical interferometer mount, as a thermo-mechanically stable mount of said beam splitter, said fixed mirror, and said movable mirror of said optical interferometer;

- (c) piezoelectrically determining and changing magnitude of optical path difference of said divided collimated object emission beam, by said optical interferometer, for generating at least one said interference image for each said magnitude of said optical path difference;
- (d) focusing and recording each said generated interference image associated with a corresponding said magnitude of optical path difference, using camera optics and a detector, for forming a plurality of recorded interference images;
- (e) improving quality of said plurality of recorded interference images, for forming a plurality of improved quality interference images; and
- (f) transforming each of said plurality of improved quality interference images to frequency domain, for forming a corresponding plurality of interferogram images.

2. A system for real time high speed high resolution hyper-spectral imaging, comprising:

- (a) an electromagnetic radiation collimating element, for collimating electromagnetic radiation emitted by objects in a scene or a sample, for forming a collimated object emission beam;
- (b) an optical interferometer, for receiving and dividing said collimated object emission beam, for generating an interference image, and for piezoelectrically determining and changing magnitude of optical path difference of said divided collimated object emission beam, for generating at least one said interference image for each said magnitude of said optical path difference; said optical interferometer includes:
 - (i) a beam splitter,
 - (ii) a fixed mirror,
 - (iii) a movable mirror, whereby said fixed mirror and said movable mirror are located at a right angle to each other, and each said mirror is oriented at a pre-determined angle relative to beam splitting surface of said beam splitter positioned at vertex of a right angle between both said mirrors,

- (iv) a piezoelectric motor, operatively connected to said movable mirror, for displacing said movable mirror along an axis of said divided collimated object emission beam,
 - (v) a distance change feedback sensor, operatively connected to said movable mirror and operatively connected to said piezoelectric motor controller, for sensing and measuring change in distance or position of said movable mirror along said axis,
 - (vi) a piezoelectric motor controller, operatively connected to said piezoelectric motor, and operatively connected to said distance change feedback sensor, for actuating and controlling said piezoelectric motor; and
 - (vii) an optical interferometer mount, as a thermo-mechanically stable mount of said beam splitter, said fixed mirror, and said movable mirror of said optical interferometer;
- (c) camera optics, for focusing each said generated interference image associated with a corresponding said magnitude of optical path difference;
 - (d) a detector, for recording each said generated interference image, for forming a plurality of recorded interference images; and
 - (e) a central programming and control/data/information signal processing unit, operatively connected to said piezoelectric motor controller and operatively connected to said detector, for programming and processing signals and for processing and analyzing said recorded interference images, for forming a corresponding plurality of interferogram images.